DOI:
10.1093/eurpub/ckt023

Document Version
Publisher's PDF, also known as Version of record

European Journal of Public Health, Vol. 23, No. 4, 594–605

doi:10.1093/eurpub/ckt023 Advance Access published on 11 March 2013

Sizable variations in circulatory disease mortality by region and country of birth in six European countries

Snorri B. Rafnsson[1], Raj S. Bhopal[1], Charles Agyemang[2], Anne Fagot-Campagna[3], Seeromanie Harding[4], Niklas Hammar[5], Ebba Hedlund[6], Knud Juel[7], Paola Primatesta[8], Michael Rosato[9], Gregoire Rey[10], Sarah H. Wild[1], Johan P. Mackenbach[11], Irene Stirbu[11,12], Anton E. Kunst[2]

1 Centre for Population Health Sciences, University of Edinburgh, UK
2 Department of Public Health, Academic Medical Centre, University of Amsterdam, The Netherlands
3 Institut de Veille Sanitaire Departement des Maladies Chroniques et Traumatismes, Saint Maurice Cedex, France
4 MRC Social and Public Health Sciences Unit, Scotland, UK
5 Department of Epidemiology, Institute of Environmental Medicine, Karolinska Institutet and AstraZeneca R&D, Sweden
6 National Board of Health and Welfare, Sweden
7 National Institute of Public Health, University of Southern Denmark, Denmark
8 Department of Epidemiology and Public Health, Royal Free and University College Medical School, University College London, UK
9 Centre for Public Health, Queen's University, Belfast, Northern Ireland
10 Inserm CépiDc, Le Kremlin-Bicêtre, France
11 Department of Public Health, Erasmus University Medical Center, Rotterdam, The Netherlands
12 The Netherlands Institute for Health Services Research (NIVEL), Utrecht, The Netherlands

Correspondence: Dr Snorri B. Rafnsson, Centre for Population Health Sciences, University of Edinburgh, Teviot Place, Edinburgh EH8 9AG, Scotland, UK, Tel: +44 (0) 131 650 3201, Fax: +44 (0) 131 650 6904, e-mail: S.B.Rafnsson@ed.ac.uk

Background: Circulatory disease mortality inequalities by country of birth (COB) have been demonstrated for some EU countries but pan-European analyses are lacking. We examine inequalities in circulatory mortality by geographical region/COB for six EU countries. **Methods:** We obtained national death and population data from Denmark, England and Wales, France, the Netherlands, Scotland and Sweden. Mortality rate ratios (MRRs) were constructed to examine differences in circulatory, ischaemic heart disease (IHD) and cerebrovascular disease mortality by geographical region/COB in 35–74 years old men and women. **Results:** South Asians in Denmark, England and Wales and France experienced excess circulatory disease mortality (MRRs 1.37–1.91). Similar results were seen for Eastern Europeans in these countries as well as in Sweden (MRRs 1.05–1.51), for those of Middle Eastern origin in Denmark (MRR = 1.49) and France (MRR = 1.15), and for East and West sub-Saharan Africans in England and Wales (MRRs 1.28 and 1.39) and France (MRRs 1.24 and 1.22). Low ratios were observed for East Asians in France, Scotland and Sweden (MRRs 0.64–0.50). Sex-specific analyses showed results of similar direction but different effect sizes. The pattern for IHD mortality was similar to that for circulatory disease mortality. Two- to three-fold excess cerebrovascular disease mortality was found for several foreign-born groups compared with the local-born populations in some countries. **Conclusions:** Circulatory disease mortality varies by geographical region/COB within six EU countries. Excess mortality was observed for some migrant populations, less for others. Reliable pan-European data are needed for monitoring and understanding mortality inequalities in Europe's multiethnic populations.

Introduction

Coronary heart disease (CHD) and stroke are two major causes of morbidity and mortality in Europe,[1] which also vary by ethnic group—this is likely to reflect differences in access to and quality of health care, psychosocial, lifestyle and physiological factors, and possibly also genetics, operating before, during and after migration.[2,3] As a result of net immigration during the second half of the 20th century,[4] Europe has become a multi-ethnic continent that is faced with important public health and health care challenges—one major task is the routine collection and production of ethnically disaggregated, national-level data on morbidity and mortality from chronic diseases, including circulatory diseases.[5,6] Such data are essential for generating aetiological hypotheses, for supporting public health policies and for informing health care strategies targeting migrant and minority ethnic populations.[7]

Ethnic group-coded, routine data on circulatory diseases in EU countries are scarce, and when available, often lack cross-country comparability regarding how ethnicity and outcomes are defined.[8] National death registers are available in most EU countries and information on country of birth (COB) of the deceased person is usually recorded on the death certificate. COB is reasonably accurate as a proxy measure for ethnic group, especially among recent migrants and older members of minority ethnic groups.[9] For a few EU countries, studies have demonstrated variation in circulatory mortality by COB.[10–17] In England and Wales, mortality was greater than the national average for people born in Bangladesh and Pakistan but lower for those born in China and Hong Kong.[17] In the Netherlands, the mortality rate was higher in people born in Surinam compared with the local-born Dutch population.[10] In Portugal, African migrants, and especially Cape Verdeans, experienced more circulatory mortality, and from specific vascular causes, than the local-born Portuguese population.[18] Finally, in Sweden, women born in Eastern European countries had a 2- to 3-fold greater risk of dying from CHD.[16] For most European countries, no published data exist on differences in circulatory disease mortality by ethnic group (Scotland

being an exception) or other proxy measure, excepting our work, no systematic analysis across European countries has been made.[8]

This study was originated in the Migrant and Ethnic Health Observatory (MEHO—project website: www.meho.eu.com), which is a EU funded methodological demonstration project. The aim of MEHO is to map, and if feasible analyse, routine data from EU countries, with the objective of generating ethnic group-specific health status indicators, including for circulatory diseases—we have already reported on differences in circulatory disease mortality by country of destination by comparing few selected COB groups across different EU countries.[19] Here, we extend the investigation of within-country variation in circulatory disease mortality by COB to six EU member states simultaneously, including some for which little or no similar information has been published. Since the health status of migrant and ethnic populations is unlikely to be fixed across countries, international comparisons are crucial for making correct inferences about the aetiology and burden of ill health and mortality in migrant populations across Europe.[20] Our objective was to determine whether within-country comparisons in one location are echoed in another.

Methods

Data

The mortality and population data used have been described elsewhere.[19] Briefly, we selected six EU countries—Denmark, England and Wales, France (excluding the overseas departments), the Netherlands, Scotland and Sweden—after assessing the comparability of EU circulatory disease mortality data.[8] Data on deaths by age, sex, COB and underlying cause of death were acquired. The mortality data were provided for variable time periods, in some countries being centred on the 3- to 5-year period around the last census year (table 1). Data were extracted using ICD-9 and/or ICD-10 codes (an exception being Denmark which used ICD-8

Table 1 Overview of study design, time period and PYR by country or region of birth for selected European countries

Country or region of birth, study design and data collection period	Individual countries of birth included in region of birth categories	Person-years at risk	
		Men	Women
Denmark, longitudinal, 1992–2001	Denmark	12 341 982	12 546 253
Asia, South	Afghanistan, Pakistan, Sri Lanka	34 283	26 013
Asia, Southeast	Thailand, Vietnam	11 264	19 243
Europe, Eastern	Bosnia/Herzegovina, Poland, Yugoslavia	66 585	83 156
Middle East	Iran, Iraq, Lebanon, Turkey	84 654	58 980
England and Wales, non-longitudinal data—fixed denominator, 1999–2003	England, Wales	52 409 325	54 207 730
Asia, South	India, Bangladesh, Pakistan, Sri Lanka	1 474 235	1 446 575
Caribbean	Belize, Guyana, Jamaica, Trinidad and Tobago, Windward Islands, Barbados, Leeward Islands, Northern Islands	446 620	537 875
Europe, Eastern	Poland, Ex-Yugoslavia, Romania, Hungary, Czech Republic, Slovakia, Albania, Bulgaria	125 150	166 010
North Africa	Egypt, Algeria, Libya, Tunisia, Morocco	108 140	71 080
Sub-Saharan Africa, East	Zambia, Malawi, Kenya, Tanzania, Uganda	441 410	418 940
Sub-Saharan Africa, South	The Republic of South Africa	103 345	124 300
Sub-Saharan Africa, West	Nigeria, Ghana, Sierra Leone, The Gambia	230 975	230 080
France, non-longitudinal data—fixed denominator, 2005–2007	France	35 936 542	38 717 357
Asia, East	China	37 258	45 219
Asia, South	Sri Lanka	33 834	25 894
Asia, Southeast	Mauritius, Cambodia, Laos, Vietnam	254 129	273 752
Caribbean	Haiti	22 578	27 881
Europe, Eastern	Poland, Romania, Ex-Yugoslavia, Ex-USSR	186 252	241 505
Latin America, Tropical	Brazil	9458	21 634
Middle East	Turkey	199 421	156 579
North Africa	Algeria, Morocco, Tunisia	2 814 391	2 570 138
Sub-Saharan Africa, Central	Congo, Democratic Republic of the Congo	93 331	79 786
Sub-Saharan Africa, East	Madagascar	76 143	99 183
Sub-Saharan Africa, West	Cameroon, Ivory Coast, Mali, Senegal	269 511	217 710
The Netherlands, longitudinal data, 1996–2006	The Netherlands	35 784 357	35 981 668
Caribbean	Antilles and Aruba, Surinam	1 094 570	1 046 892
Middle East	Turkey	564 497	458 149
North Africa	Morocco	484 206	339 418
Scotland, non-longitudinal data—fixed denominator, 1999–2003	Scotland	5 101 665	5 549 010
Asia, East	China	15 825	15 985
Asia, South	Pakistan, India, Bangladesh	43 325	38 215
Sweden, non-longitudinal data—variable denominator, 1990–2006	Sweden	28 982 698	28 925 653
Asia, East	China, North and South Korea	32 623	41 064
Asia, South	India	25 336	19 631
Asia, Southeast	Thailand, Vietnam	35 663	83 404
Europe, Eastern	Poland, Total former Yugoslavia, Former USSR-European part, Baltic States, Former USSR-Eastern part, Eastern Europe	1 062 768	1 390 244
Latin America, Southern	Chile	103 618	106 217
Middle East	Iraq, Iran, Lebanon, Turkey	597 713	425 171
Sub-Saharan Africa, East	Ethiopia, Eretria, Somalia	78 120	55 807

and ICD-10): total circulatory disease ICD-9 390–459, ICD-10: I00–I99; ischaemic heart disease (IHD) ICD-9 410–414, ICD-10 I20–I25 and cerebrovascular disease ICD-9 430–438, ICD-10 I60–I69.

The following criteria were used to select COB groups: (i) the focus of MEHO project, which was on predominantly socioeconomically deprived migrant populations originating outside Western Europe and the OECD countries; (ii) sufficient size of population for meaningful analysis (see further below). We also adopted the Global Burden of Disease[21] project's approach in constructing geographical categories in order to harmonize the exposure categories—different migration history and patterns have contributed to relative sizes of different COB groups in different countries—and to reduce the number of exposure categories per study country. Therefore, we included only COBs with more than four deaths and person-years at risk (PYR) equal or greater than 30 000 for men and women combined. Any given geographical category could include a single or more COBs (table 1).

The analysis was restricted to those aged 35–74 years because: (i) few circulatory deaths occur in people under 35 years, (ii) there are important differences in age structure between men and women older than 74 years, (iii) there may be more inaccuracies in death certification in those older than 75 years, (iv) for some ethnic groups, younger age groups may have a significant proportion born in the destination country and (v) older populations may have significant number of European ethnic groups born overseas.

Ethics

As our data were completely anonymized, ethical approval was deemed unnecessary.

Statistical analysis

We computed mortality rate ratios (MRRs) for foreign- and local-born persons in each study country based on Poisson loglinear models using PASW Statistics version 17. We related the number of deaths to the amount of observed PYR, using PYR as offset and COB as an independent variable, in two sets of models: sex-combined models adjusting for age and sex and sex-specific models adjusting for age. Precision was estimated by the 95% CIs. In table 2 and figures 1–3, comparisons of foreign- vs. local-born populations were described as similar when the associated 95% CIs included 1; findings were described as different when the 95% CIs did not include 1.

Results

Circulatory disease mortality

Here, we focus on the results for foreign-born men and women combined for each study country. Overall, as shown in table 2, we observed a consistently high mortality in the South Asia and Eastern Europe-born in Denmark, England and Wales, France and Sweden (Eastern Europeans only). For example, the MRRs for Eastern Europeans and South Asians in Denmark were 1.51 and 1.91, respectively. Other COBs experiencing high mortality included the Middle East-born in Denmark and France, and the East and West sub-Saharan Africa-born in England and France. In contrast, we found low mortality in East Asians in France, Scotland and Sweden. For example, in France, the East Asia-born had 50% lower mortality than the local-born. More specifically, our sex-specific analyses showed that the MRRs had a similar direction for men and women although their size differed (figure 1A–F).

IHD mortality

As shown in table 2, we observed generally high mortality from IHD among South Asians and Eastern Europeans in Denmark, England and Wales, France and Sweden (Eastern Europeans only). For example, MMRs for South Asians and Eastern Europeans in Denmark were 2.02 and 1.39, respectively. Excess deaths were also noted for the Middle East-born in Denmark and France. For example, in Denmark, they had an MRR of 1.77. In contrast, people born in the sub-Saharan African regions had low or only moderately high mortality. As an example, West and South Africans in England and Wales had an MRR equal to 0.68 and 0.75, respectively. The sex-specific analysis showed a similar pattern for men and women (figure 2A–F).

Cerebrovascular disease mortality

We noted overall high mortality from cerebrovascular disease among Southeast Asians in Denmark, France and Sweden; South Asians in Denmark, England and Wales, France and Scotland; Eastern Europeans in Denmark, England and Wales and Sweden and the Middle East-born in Denmark. For example, in Denmark, the MRRs for these groups ranged from 1.93 to 1.24, respectively. East and West sub-Saharan Africans in England and Wales, France and Sweden also had high mortality. In England and Wales, the MRRs were 1.33 and 2.30, respectively. The sex-specific associations had a similar direction for men and women although the ratios differed in magnitude (figure 3A–F).

Discussion

Main findings

To our knowledge, this is the first time national death rates have been calculated simultaneously for several European countries using pre-defined data specification criteria to examine within-country inequalities in total and cause-specific circulatory disease mortality by birth country. Our results show considerable and fairly consistent mortality inequalities between foreign- and local-born groups. For example, the South Asia and Eastern Europe-born had consistently high mortality across countries and cause of death. Other groups, such as the East Asia-born, had low mortality when data were available. Some COBs had low or high rates in some countries but not all.

Comparison with previous studies

Published studies on circulatory mortality are country-specific and only available for a few EU countries.[12,13,15,17,18,22] Our data corroborate previous findings from England and Wales where men and women born in India, Pakistan, Bangladesh, Eastern Europe, East and West Africa (West Africans had low IHD mortality) were found to have high mortality.[17] Dutch data also showed high circulatory and cerebrovascular mortality in the Surinam-born but low among the Morocco-born.[10] The increase in mortality risk was only modest in the India-, Pakistan- and Bangladesh-born residing in Scotland.[11] In Sweden, high mortality was observed for Eastern European women (especially from IHD) but not men.[16] We also observed high IHD mortality in women. In addition, we showed high cerebrovascular disease mortality in Eastern Europeans in Sweden, especially in women.

In contrast, very little research has been done previously on mortality among immigrants in France, a country historically resistant to examining statistics by ethnic group where it was not considered as relevant variable for routine statistics. This consideration may have the side-effect of hiding inequalities. One French report noted how Moroccan men had relatively low circulatory mortality; Moroccan women had high mortality from 'other diseases of the circulatory system', but there were no differences in either IHD or cerebrovascular mortality.[23] We found similar contrasted results for men and women from North Africa. Furthermore, there is only limited previous information on cause-specific mortality in migrants in Denmark. Possibly for the

Table 2 Region of birth inequalities in cause-specific circulatory disease mortality in selected European countries; figures are number of deaths, age and sex-adjusted MRRs[a] and 95% confidence intervals (CI)

Region of birth	Circulatory disease[b]			Ischaemic heart disease[c]			Cerebrovascular disease[d]		
	Deaths	MRR	95% CI	Deaths	MRR	95% CI	Deaths	MRR	95% CI
Denmark (ref.)	65 727	1.00	–	35 617	1.00	–	13 278	1.00	–
Asia, South	110	1.91	1.58–2.30	62	2.02	1.57–2.59	23	1.92	1.28–2.89
Asia, Southeast	46	0.91	0.68–1.22	9	0.42	0.22–0.80	20	1.93	1.25–3.00
Europe, Eastern	307	1.51	1.35–1.69	149	1.39	1.18–1.63	67	1.55	1.22–1.97
Middle East	241	1.49	1.31–1.69	154	1.77	1.51–2.07	41	1.24	0.91–1.68
England and Wales (ref.)	260 587	1.00	–	158 504	1.00	–	48 170	1.00	–
Asia, South	9157	1.44	1.41–1.47	6362	1.63	1.59–1.67	1744	1.53	1.46–1.61
Caribbean	3379	1.16	1.13–1.20	1477	0.83	0.79–0.87	899	1.71	1.60–1.83
Europe, Eastern	1251	1.20	1.14–1.27	748	1.19	1.11–1.28	233	1.18	1.04–1.34
North Africa	349	1.11	1.00–1.24	204	1.06	0.92–1.22	64	1.14	0.89–1.45
Sub-Saharan Africa, East	1351	1.28	1.22–1.35	882	1.37	1.28–1.47	253	1.33	1.18–1.51
Sub-Saharan Africa, South	353	0.86	0.78–0.96	184	0.75	0.65–0.86	73	0.95	0.75–1.19
Sub-Saharan Africa, West	718	1.39	1.29–1.50	216	0.68	0.60–0.78	210	2.30	2.01–2.63
France (ref.)	79 010	1.00	–	27 319	1.00	–	16 475	1.00	–
Asia, East	24	0.50	0.34–0.75	4	0.24	0.09–0.63	15	1.52	0.92–2.52
Asia, South	41	1.37	1.01–1.86	18	1.62	1.02–2.57	12	2.03	1.15–3.58
Asia, Southeast	470	0.99	0.90–1.08	161	0.96	0.82–1.12	141	1.45	1.23–1.71
Caribbean	25	0.94	0.63–1.39	–	–	–	10	1.84	0.99–3.43
Europe, Eastern	523	1.27	1.16–1.38	178	1.24	1.07–1.44	115	0.99	0.82–1.19
Latin America, Tropical	5	0.35	0.14–0.84	–	–	–	–	–	–
Middle East	274	1.15	1.02–1.29	132	1.49	1.26–1.77	51	1.09	0.83–1.44
North Africa	5880	0.90	0.88–0.93	2228	0.96	0.92–1.00	1198	0.92	0.86–0.97
Sub-Saharan Africa, Central	112	1.34	1.11–1.61	17	1.23	0.95–1.60	46	2.78	2.08–3.71
Sub-Saharan Africa, East	165	1.24	1.07–1.45	57	0.54	0.34–0.88	45	1.63	1.22–2.18
Sub-Saharan Africa, West	419	1.22	1.11–1.35	110	0.85	0.71–1.03	132	2.10	1.69–2.39
The Netherlands (ref.)	138 870	1.00	–	62 201	1.00	–	25 846	1.00	–
Caribbean	2861	1.16	1.11–1.20	1145	1.01	0.95–1.07	771	1.75	1.63–1.88
Middle East	1197	1.05	0.99–1.11	577	1.09	1.00–1.18	253	1.28	1.13–1.44
North Africa	662	0.62	0.58–0.67	262	0.53	0.47–0.59	166	0.94	0.80–1.09
Scotland (ref.)	35 107	1.00	–	22 025	1.00	–	6949	1.00	–
Asia, East	35	0.52	0.37–0.72	16	0.37	0.23–0.61	13	1.00	0.58–1.72
Asia, South	229	0.97	0.85–1.11	150	0.10	0.85–1.17	52	1.17	0.89–1.54
Sweden (ref.)	148 643	1.00	–	89 351	1.00	–	27 636	1.00	–
Asia, East	69	0.64	0.51–0.81	26	0.46	0.32–0.68	27	1.34	0.92–1.96
Asia, South	67	0.99	0.78–1.26	45	1.11	0.83–1.48	9	0.74	0.39–1.43
Asia, Southeast	65	0.80	0.63–1.02	18	0.40	0.25–0.63	33	2.00	1.42–2.81
Europe, Eastern	5583	1.05	1.03–1.08	3407	1.08	1.04–1.12	1072	1.08	1.01–1.15
Latin America, Southern	138	0.37	0.17–0.83	70	0.32	0.10–1.01	38	0.32	0.04–2.29
Middle East	969	0.84	0.79–0.89	620	0.92	0.85–0.99	159	0.74	0.63–0.86
Sub-Saharan Africa, East	75	0.73	0.59–0.92	36	0.62	0.45–0.86	22	1.12	0.74–1.70

[a]MRRs (with 95% confidence intervals) from Poisson loglinear regression analysis (region of birth categories with ≤ 3 deaths and $< 30\,000$ PYR for men and women combined were excluded).
[b]ICD9: 390–459; ICD10: I00–I99.
[c]ICD9: 410–414; ICD10: I20–I25.
[d]ICD9: 430–438; ICD10: I60–I69 (an exception from this is Denmark which used ICD-8 and ICD-10).

first time, we showed high mortality in men and women of Middle Eastern and Eastern European origin. This pattern was observed for all three analyses of circulatory mortality.

Study limitations

Here, we consider the quality of the underlying data and the potential impact of selection bias. The data from Denmark and the Netherlands were based on linked population and death registers, where the denominator is exact. For England and Wales, France, Scotland and Sweden, this is not the case. Such data may be more prone to bias arising from COB misclassification, leading to numerator–denominator bias.[13] Also, incomplete COB registration may underestimate the level of mortality. To reduce this risk, we examined mortality for broad geographical categories. Moreover, the data include different time periods. Although important declines in circulatory mortality have been achieved over time, our results may possibly reflect different risks than the current ones.

We used birth country as a proxy for ethnicity although COB tends to be less valuable in younger age groups. COB criteria also fail to distinguish between different ethnic groups coming from the same birth country. Recent work from the Scottish Health and Ethnicity Linkage Study[24,25] shows that circulatory disease outcomes by ethnic group tend to be similar to those in COB analyses, although differences seem to be greater with ethnic group. We could not assess the completeness of COB coding on death certificates but the absence of such information would underestimate the size of the numerator. In the event of misclassification of COB, i.e. where the wrong COB was recorded, we would expect a reduction in the strength of our associations.

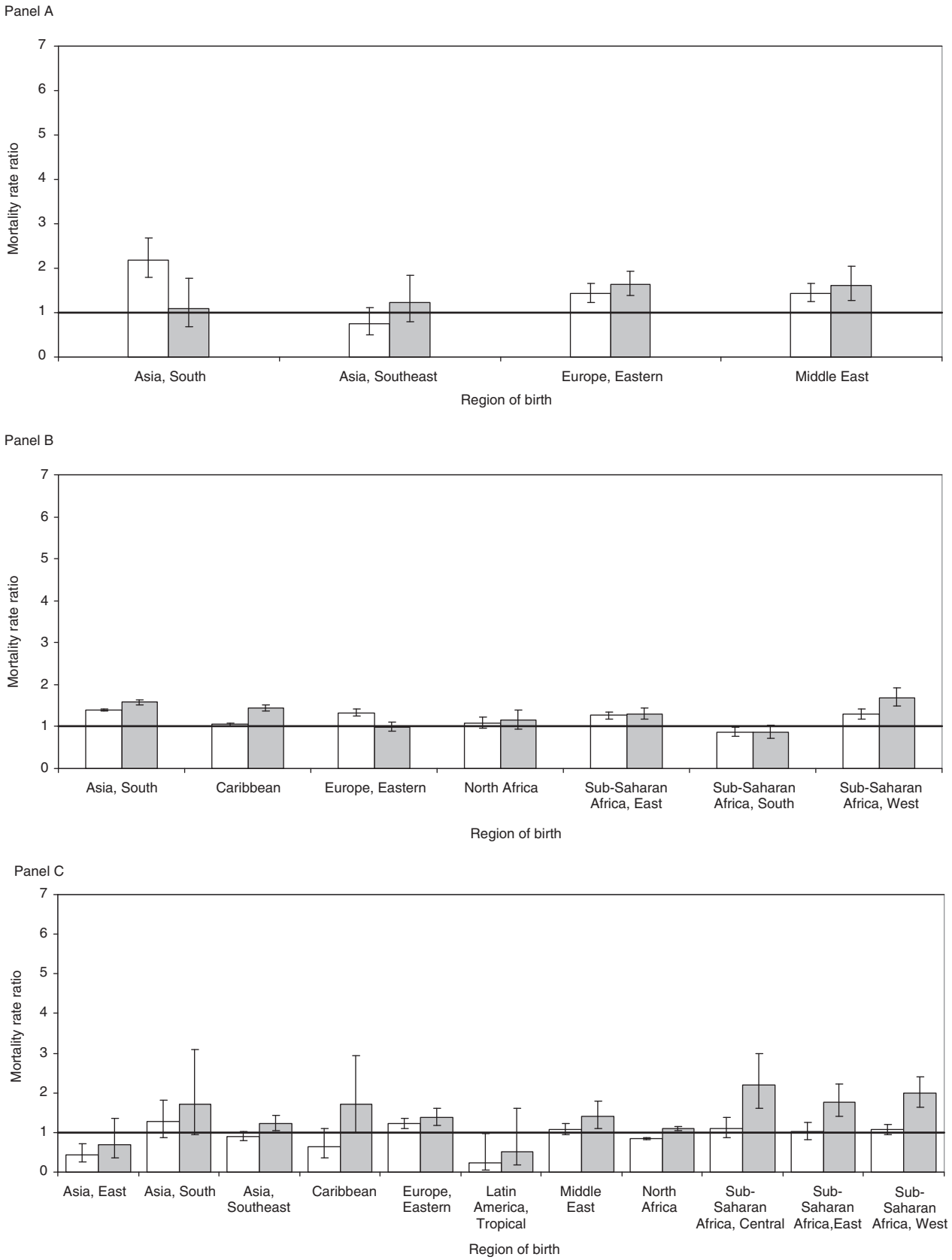

Figure 1 Inequalities in circulatory disease mortality by region of birth and sex in selected European countries. The graphs show age-adjusted MRRs and 95% CIs for men (white columns) and women (grey columns). (A) Denmark (MRR = 1 for local-born population), (B) England and Wales (MRR = 1 for local-born population), (C) France (MRR = 1 for local-born population), (D) the Netherlands (MRR = 1 for local-born population), (E) Scotland (MRR = 1 for local-born population) and (F) Sweden (MRR = 1 for local-born population)

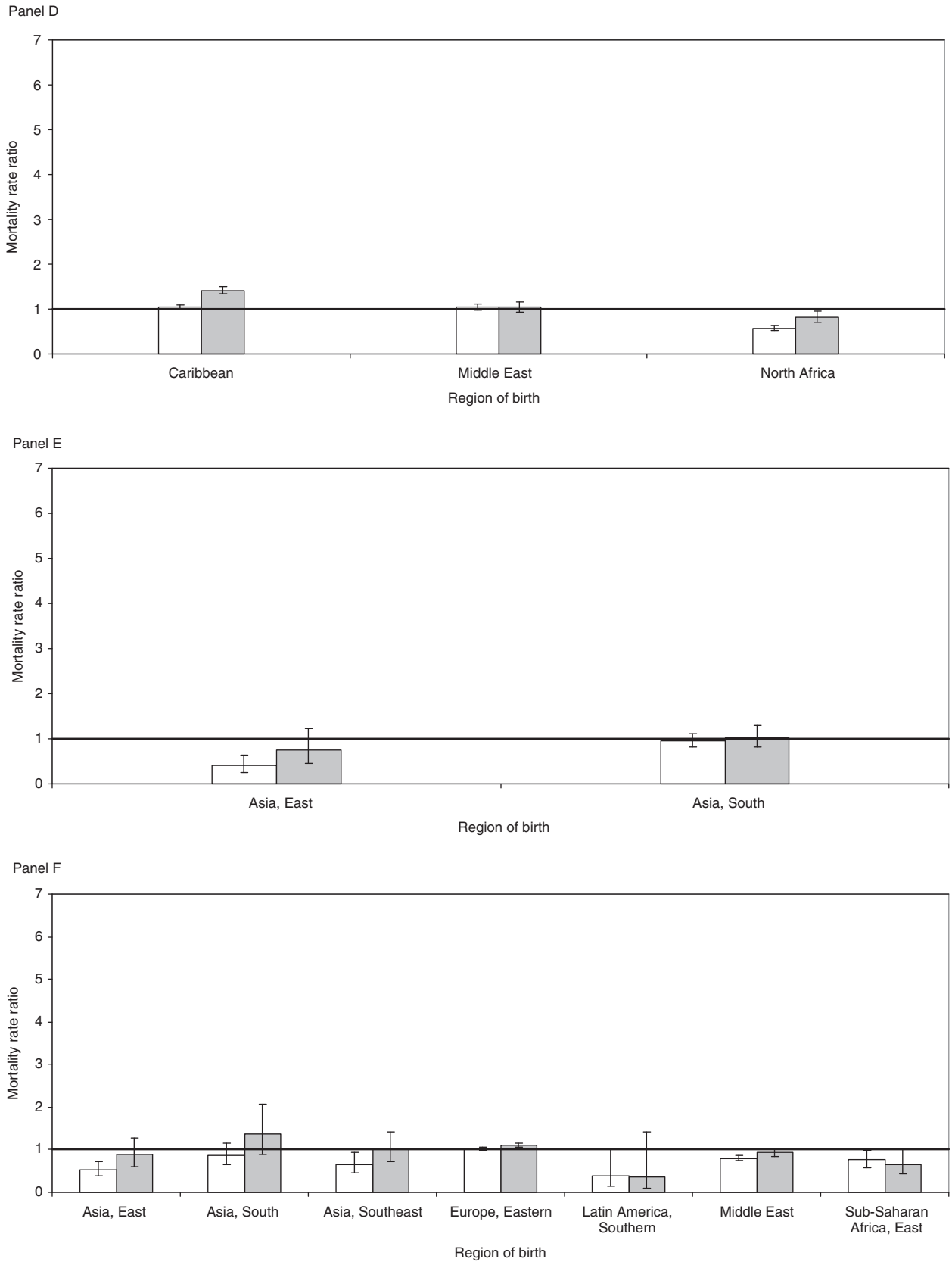

Figure 1 (Continued)

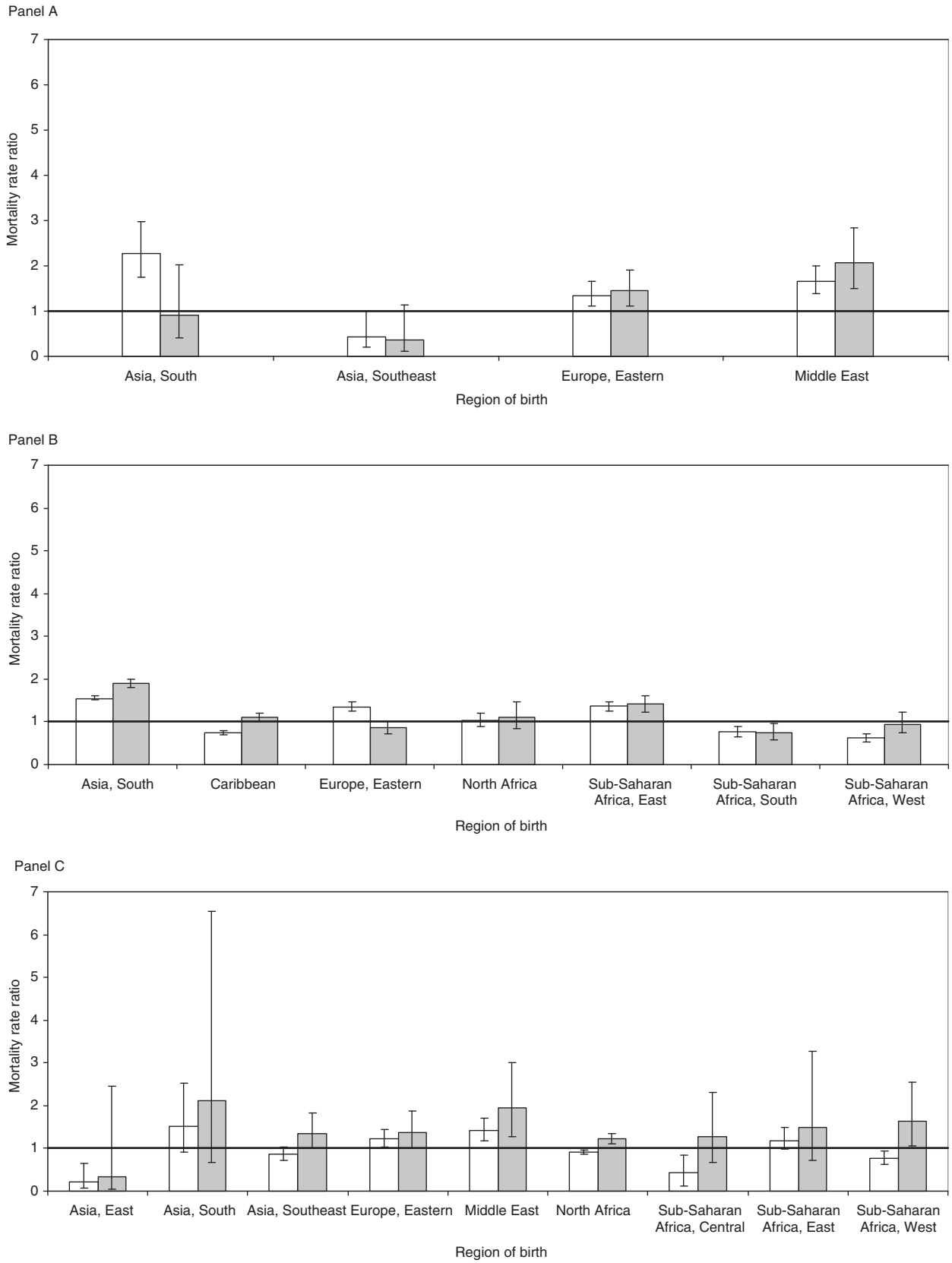

Figure 2 Inequalities in IHD mortality by region of birth and sex in selected European countries. The graphs show age-adjusted MRRs and 95% CIs for men (white columns) and women (grey columns). (A) Denmark (MRR = 1 for local-born population), (B) England and Wales (MRR = 1 for local-born population), (C) France (MRR = 1 for local-born population), (D) the Netherlands (MRR = 1 for local-born population), (E) Scotland (MRR = 1 for local-born population) and (F) Sweden (MRR = 1 for local-born population)

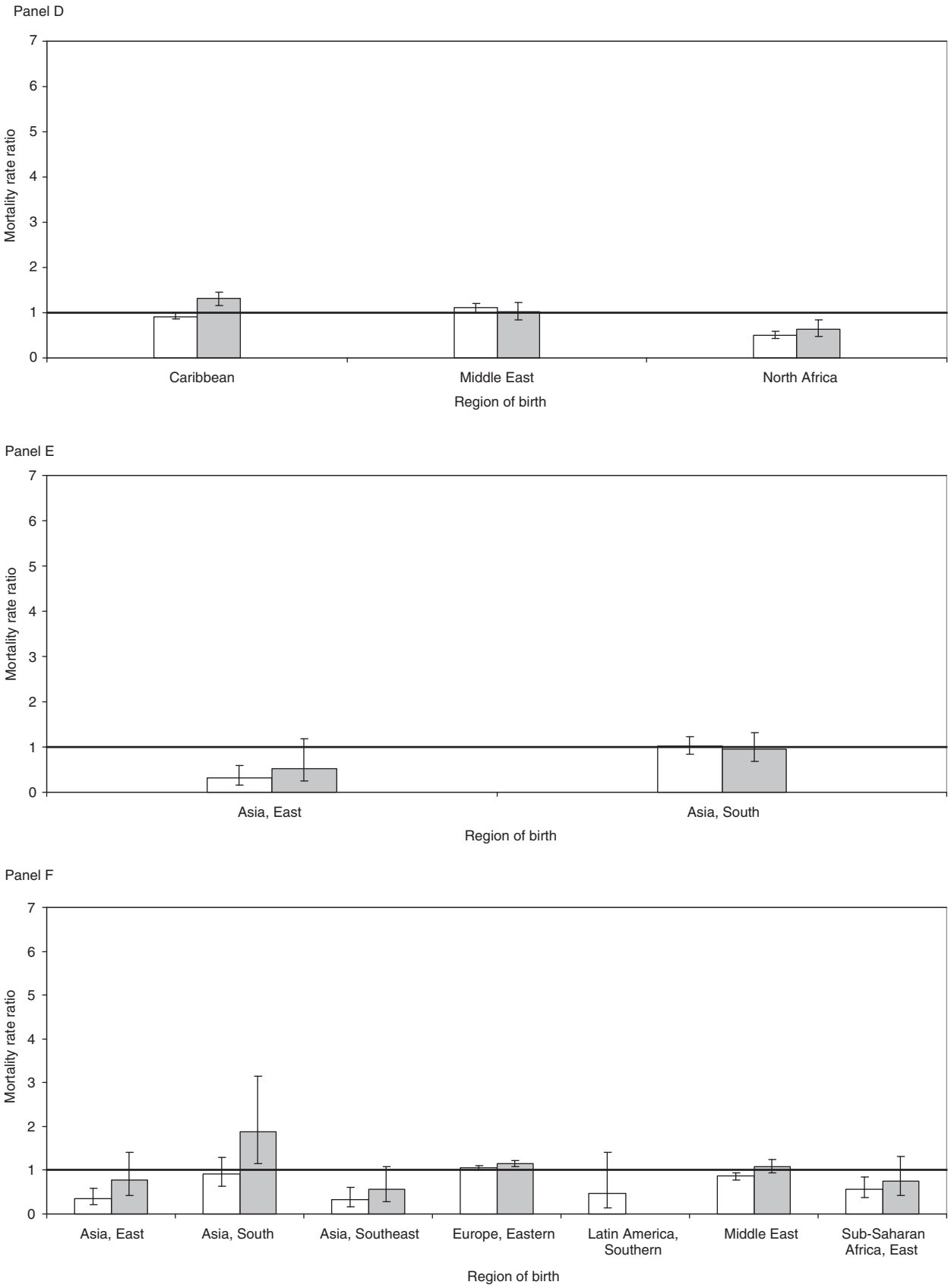

Figure 2 (Continued)

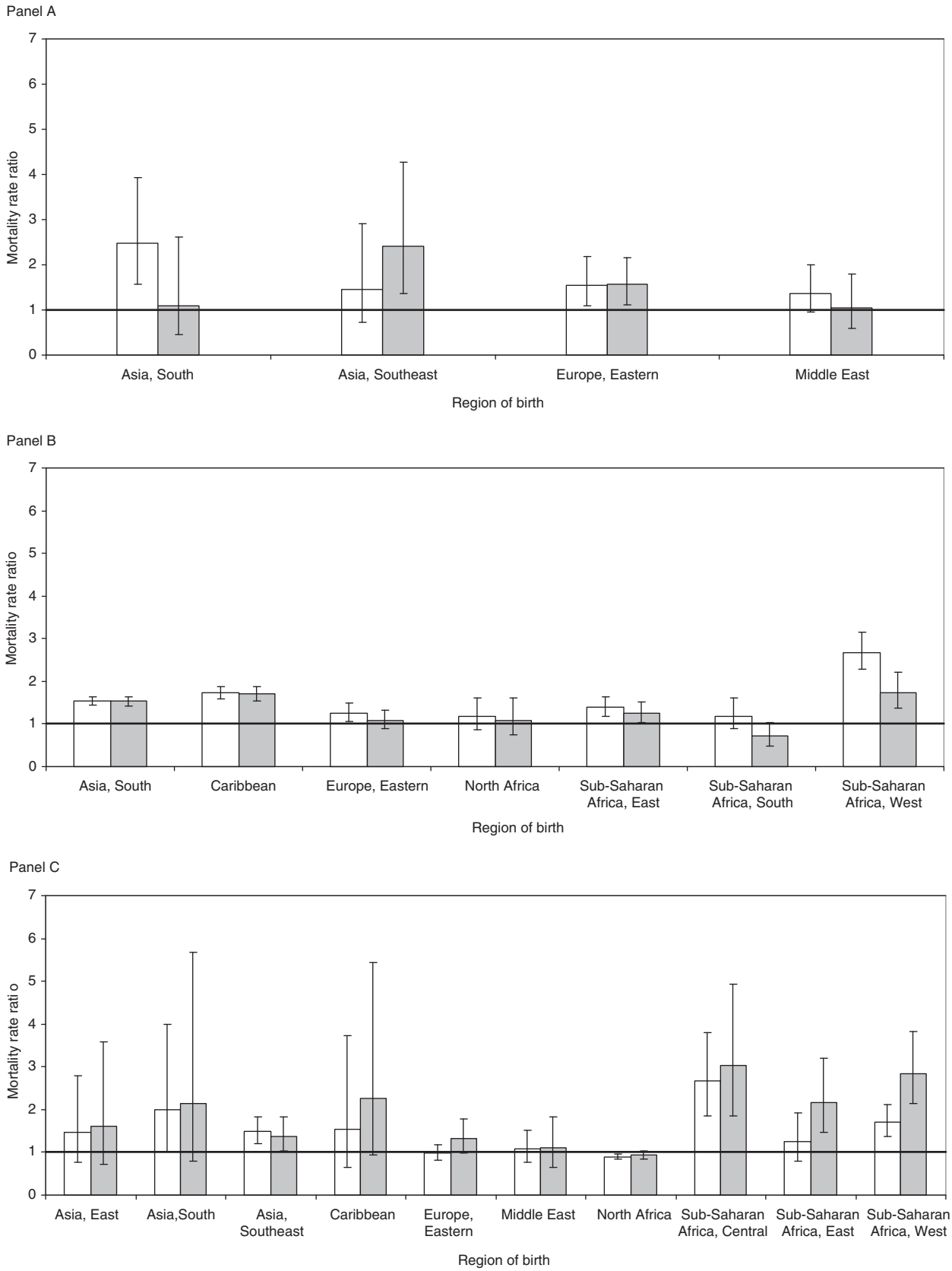

Figure 3 Inequalities in cerebrovascular disease mortality by region of birth and sex in selected European countries. The graphs show age-adjusted MRRs and 95% CIs for men (white columns) and women (grey columns). (A) Denmark (MRR = 1 for local-born population), (B) England and Wales (MRR = 1 for local-born population), (C) France (MRR = 1 for local-born population), (D) the Netherlands (MRR = 1 for local-born population), (E) Scotland (MRR = 1 for local-born population) and (F) Sweden (MRR = 1 for local-born population)

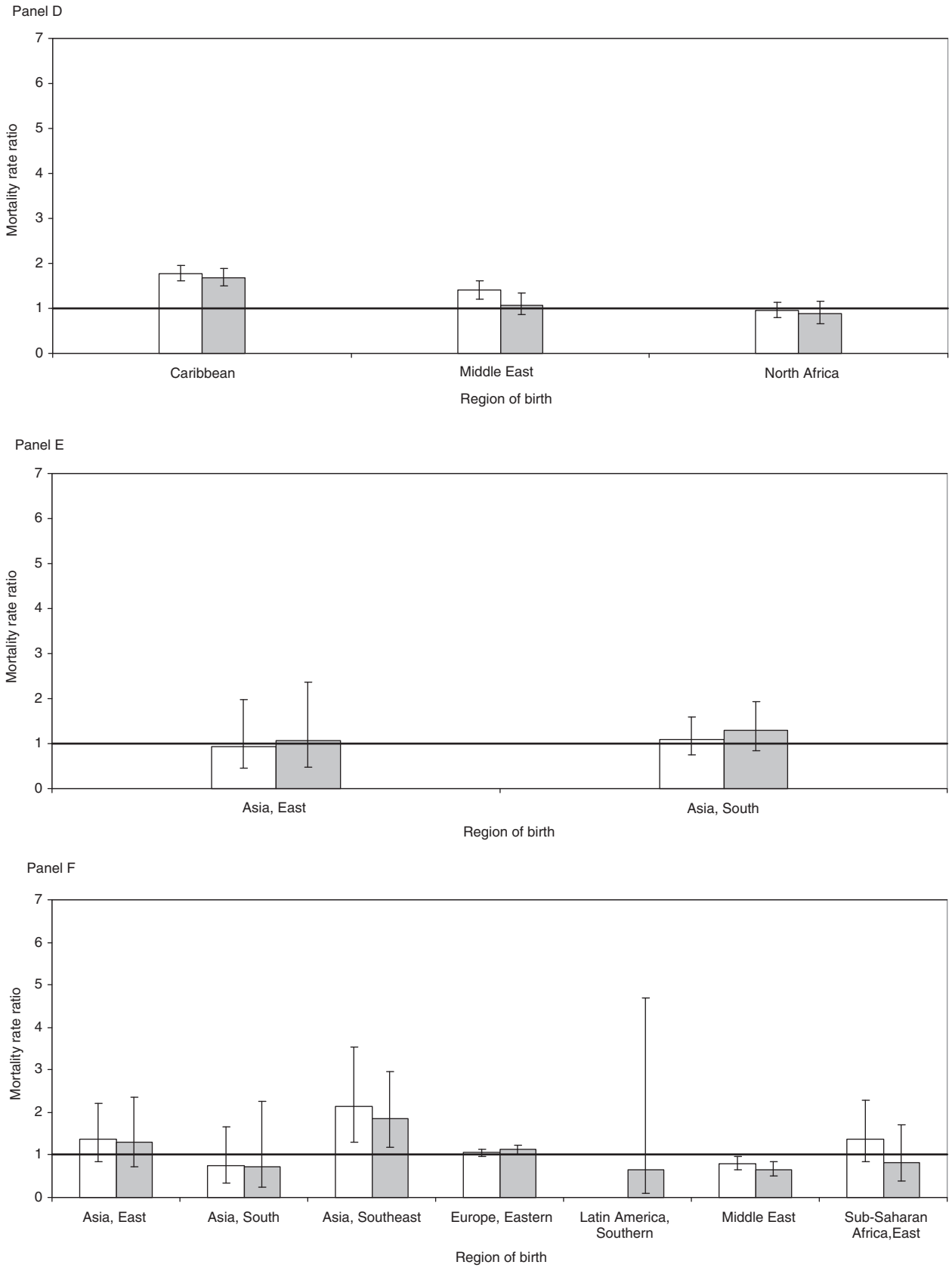

Figure 3 (Continued)

The general lack of information on individual-level characteristics (such as education) in the data prevented us from examining the effects of these factors on COB and mortality. Some countries, e.g. Denmark and Sweden, and more recently Scotland through linked data,[24,25] have the possibility to enrich the data in this way for use in future studies although information on critical cardiovascular risk factors is usually lacking. Migrants from the same COB may differ in sociodemographic characteristics and health behaviours in different countries of settlement. This may be attributed to the specific background of the migrants or to the national context of the host country.[19,26]

A delay or absence of recording of re-migration may underestimate mortality risk, i.e. so-called 'salmon bias'. In Sweden, this type of error has been estimated to be in the order of 3–7% of all migrants on a yearly basis.[27] It is possible that migrants from certain countries are more implicated than others.[17]

Potential misclassification may result if a disease is more or less likely to be recorded as the underlying cause of death for a particular COB. Although further studies are required, there is evidence that the validity of cause of death coding varies by country.[28]

Finally, the possibility of type 1 and type 2 errors affecting our results should be considered. Although our statistical analysis was based on a number of formal comparisons, type 1 error is an unlikely explanation for the main results which largely corroborate findings from previous studies. Similarly, in order to reduce the likelihood of type 2 error, we grouped individual birth countries into geographical regions if the number of deaths and underlying population size was less than our pre-specified criteria indicated.

Possible explanations

A number of explanations have been proposed for the observed migrant and ethnic inequalities in circulatory disease mortality. Major conventional vascular risk factors are likely to be important in ethnic minority populations although data on the prevalence and prospective relationship between these factors and mortality are still lacking for many groups and most European countries.[8,29] Moreover, emerging data suggest that the excess burden of IHD and cerebrovascular disease in some ethnic populations (e.g. South Asians in the UK) may not be fully accounted for by differences in conventional risk factors.[30]

Prevalence data show high levels of smoking in Eastern European, Turkish and Middle Eastern migrants,[31,32] while South Asians in the UK tend to have similar or lower smoking levels than the general population, although important within-group sex differences also exist.[33] They also have low physical activity levels, especially Bangladeshis.[34,35] Eastern European, Turkish and Middle Eastern men, and African women, have high levels of overweight and obesity.[31,36,37] In Sweden, Turkish women have high body mass index (BMI), waist circumference and waist-to-hip ratio.[38] UK South Asians have more central obesity than Europeans for the same level of BMI.[30] Central obesity is a strong predictor of CHD in this population.[30,39] There are high levels of hyperinsulinaemia and diabetes in sub-Saharan African migrants,[37] and in Turkish and Middle Eastern migrants in Denmark.[40] Hypertension, the prevalence of which is increased in sub-Saharan Africans for unknown reasons, is thought to contribute to their high stroke risk.[37]

In contrast, some migrant and ethnic populations have consistently low mortality from circulatory disease (or from particular causes) although there have been only limited efforts to account for these patterns. For some migrant groups, the low burden of circulatory disease might occur as a result of selective migration of healthy individuals, i.e. the so-called 'healthy migrant effect'. However, why this would affect only some causes and migrant groups is not clear. Alternatively, more favourable risk factor levels may play a role here although more prevalence data are urgently needed.[37]

In conclusion, our results describe inequalities in circulatory disease mortality between foreign-born and local-born populations in six European countries, with substantial excess mortality observed for some migrant populations (and lower mortality in others) which is consistent across countries. The results highlight the need for collecting better health information among migrant populations across the EU in order to help understand these inequalities. The MEHO project has illustrated not only the interest and value of such data but also that it is feasible to collect, analyse systematically, interpret and utilize such data to provide perspectives beyond that achievable by single-country analyses, invaluable as the latter are.

Acknowledgements

This article is a product of collaboration between Work Packages 5 and 6 of the MEHO project. We thank Dr Irina Stirbu for compiling the mortality data sets for Denmark, England and Wales and the Netherlands. This work has benefitted from numerous discussions within the MEHO collaboration and we acknowledge the MEHO project leaders, Marc Bruijnzeels, Semiha Denktas and Marleen Foets (Erasmus Medical Centre, the Netherlands), and the leaders of other MEHO Work Packages and their teams: Laura Cacciani, Emanuela Forcella, Aldo Rosano (Agenzia di Sanità Pubblica della Regiona Lazio, Italy); Allan Krasnik and Signe Nielsen (University of Copenhagen, Denmark); Oliver Razum, Jacob Spallek and Anna Reeske (University of Bielefeld, Germany); Alexander Kramer and Manas Akmatov (University of Bielefeld, Germany); Kvetoslava Rimarova (University of Slovenia) and Dineke Zeegers (European Public Health Association). We thank the members in the MEHO-CVD network for their ongoing support and contributions and whose names are listed in a previous publication.[8] This work has been presented in part orally at the following conferences: the second joint European Public Health Conference, Lodz, Poland (November 2009); the third European Migrant and Ethnic Health Conference, Pecs, Hungary (May 2010) and annual European Public Health conference, Copenhagen, Denmark (November 2011).

Funding

The MEHO project was supported by DG SANCO (grant agreement number 2005122).

Conflicts of interest: None declared.

Key points

- Europe is faced with many public health challenges, including the routine collection and production of ethnically disaggregated, national-level data on morbidity and mortality from chronic diseases.
- The MEHO project aimed to map, acquire and analyse routine data from EU countries with the objective of generating migrant and ethnic group-specific health status indicators for five independent health areas, including circulatory diseases and diabetes.
- Our analysis demonstrated inequalities in circulatory disease mortality between foreign-born and local-born populations in six EU countries, with substantial excess mortality observed for some migrant populations, and lower mortality in others.
- These results highlight the need for collecting better health information among migrant populations in order to help better understand the observed inequalities.
- By helping to fill the gap in available information, the present findings are highly relevant for European public health polices addressing migrant health issues.

References

1 Allender S, Scarborough P, Peto V, et al. European cardiovascular disease statistics 2008. Available at: http://www.ehnheart.org/cvd-statistics.html (27 December 2011, date last accessed).

2 Spallek J, Zeeb H, Razum O. What do we have to know from migrants' past exposures to understand their health status? A life course approach. *Emerg Themes Epidemiol* 2011;8:6.

3 Bhopal R. *Ethnicity, Race, and Health in Multicultural Societies: Foundations for Better Epidemiology, Public Health, and Health Care*. Oxford: Oxford University Press, 2007.

4 Wanner P. Migration trends in Europe. European Population Papers Series No 7. Available at: http://www2.unine.ch/repository/default/content/sites/sfm/files/shared/pub/o/o_09.pdf (26 June 2012, date last accessed).

5 Bhopal R. Chronic diseases in Europe's migrant and ethnic minorities: challenges, solutions and a vision. *Eur J Public Health* 2009;19:140–3.

6 Rafnsson SB, Bhopal RS. Migrant and ethnic health research: report on the European Public Health Association Conference 2007. *Public Health* 2008;122:532–4.

7 Carballo M. Non-communicable diseases, Chapter 4. In: Fernandes A, Carballo M, Malheiros J, Miguel JP, editors. *Challenges for Health in the Age of Migration: Health and Migration in the European Union*. Available at: http://www.pro-brook.com/images/PDFs /Portugal%20EU%20health.pdf (12 November 2011, date last accessed).

8 Rafnsson SB, Bhopal RS. Large-scale epidemiological data on cardiovascular diseases and diabetes in migrant and ethnic minority groups in Europe. *Eur J Public Health* 2009;19:484–91.

9 Stronks K, Kulu-Glasgow I, Agyemang C. The utility of 'country of birth' for the classification of ethnic groups in health research: the Dutch experience. *Ethn Health* 2009;14:1–14.

10 Bos V, Kunst AE, Keij-Deerenberg IM, et al. Ethnic inequalities in age- and cause-specific mortality in The Netherlands. *Int J Epidemiol* 2004;33:1112–9.

11 Fischbacher CM, Steiner M, Bhopal R, et al. Variations in all cause and cardiovascular mortality by country of birth in Scotland, 1997–2003. *Scott Med J* 2007;52:5–10.

12 Harding S. Mortality of migrants from the Indian subcontinent to England and Wales: effect of duration of residence. *Epidemiology* 2003;14:287–92.

13 Harding S, Rosato M, Teyhan A. Trends for coronary heart disease and stroke mortality among migrants in England and Wales, 1979–2003: slow declines notable for some groups. *Heart* 2008;94:463–70.

14 Hedlund E, Lange A, Hammar N. Acute myocardial infarction incidence in immigrants to Sweden. Country of birth, time since immigration, and time trends over 20 years. *Eur J Epidemiol* 2007;22:493–503.

15 Regidor E, Astasio P, Calle ME, et al. The association between birthplace in different regions of the world and cardiovascular mortality among residents of Spain. *Eur J Epidemiol* 2009;24:503–12.

16 Sundquist J, Johansson SE. The influence of country of birth on mortality from all causes and cardiovascular disease in Sweden 1979–1993. *Int J Epidemiol* 1997;26:279–87.

17 Wild SH, Fischbacher C, Brock A, et al. Mortality from all causes and circulatory disease by country of birth in England and Wales 2001–2003. *J Public Health* 2007;29:191–8.

18 Harding S, Teyhan A, Rosato M, Santana P. All cause and cardiovascular mortality in African migrants living in Portugal: evidence of large social inequalities. *Eur J Cardiovasc Prev Rehabil* 2008;15:670–6.

19 Bhopal RS, Rafnsson SB, Agyemang C, et al. Mortality from circulatory diseases by specific country of birth across six European countries: test of concept. *Eur J Public Health* 2011;22:353–9.

20 Atkin K, Bradby H, Harding S, et al. Editorial. *Ethn Health* 2010;15:213–21.

21 Global Burden of Diseases. *Injuries and Risk Factors Study Operations Manual*. Available at: http://www.globalburden.org/gbdops.html (20 December 2011, date last accessed).

22 Klinthäll M, Lindström M. Migration and health: a study of effects of early life experiences and current socio-economic situation on mortality of immigrants in Sweden. *Ethn Health* 2011;16:601–23.

23 Courbage Y, Khlat M. Mortality and causes of death of Moroccans in France, 1979–91. *Population* 1996;8:59–94.

24 Bhopal RS, Bansal N, Fischbacher CM, et al. Ethnic variations in the incidence and mortality of stroke in the Scottish Health and Ethnicity Linkage Study of 4.65 million people. *Eur J Prev Cardiol* 2012;19:1503–8.

25 Bhopal RS, Bansal N, Fischbacher C, et al. Ethnic variations in chest pain and angina in men and women: Scottish Health and Ethnicity Linkage Study of 4.65 million people. *Eur J Prev Cardiol* 2012;19:1250–7.

26 Agyemang C, Kunst AE, Bhopal R, et al. A cross-national comparative study of metabolic syndrome among non-diabetic Dutch and English ethnic groups. *Eur J Public Health* 2012, doi: 10.1093/eurpub/cks041[Epub ahead of print, 28 April 2012].

27 The overcoverage in the Total Population Register. Population and Welfare Statistics. 2010;5. Statistics Sweden. Available at: http://www.scb.se/statistik/_publikationer/BE9999_2009A01_BR_BE96BR1005.pdf (19 December 2011, date last accessed).

28 Ahern RM, Lozano R, Naghavi M, et al. Improving the public health utility of global cardiovascular mortality data: the rise of ischemic heart disease. *Popul Health Metr* 2011;9:8.

29 Bhopal RS. Coronary heart disease in South Asians: the scale of the problem and the challenge. In: Patel KCR, Bhopal RS, editors. *The Epidemic of Coronary Heart Disease in South Asian Populations: Causes and Consequences*. Birmingham, UK: South Asian Health Foundation, 2003: 1–18.

30 Kooner J, Chambers JC. Conceptualising the causes of coronary heart disease in South Asians. In: Patel KCR, Bhopal RS, editors. *The Epidemic of Coronary Heart Disease in South Asian Populations: Causes and Consequences*. Birmingham, UK: South Asian Health Foundation, 2003;19–47.

31 Haas GM, Parhofer KG, Schwandt P. Prevalence of cardiovascular disease risk factors in migrants participating in the PEP Family Heart Study, Nuremberg. *Int J Prev Med* 2010;1:19–28.

32 Uitewaal PJ, Manna DR, Bruijnzeels MA, et al. Prevalence of type 2 diabetes mellitus, other cardiovascular risk factors, and cardiovascular disease in Turkish and Moroccan immigrants in North West Europe: a systematic review. *Prev Med* 2004;39:1068–76.

33 Zaidi Q. Smoking and smoking cessation in South Asian communities. In: Patel KCR, Bhopal RS, editors. *The Epidemic of Coronary Heart Disease in South Asian Populations: Causes and Consequences*. Birmingham, UK: South Asian Health Foundation, 2003;118–25.

34 Fischbacher CM, Hunt S, Alexander L. How physically active are South Asians in the United Kingdom? A literature review. *J Public Health* 2004;26:250–8.

35 Williams ED, Stamatakis E, Chandola T, Hamer M. Assessment of physical activity levels in South Asians in the UK: findings from the Health Survey from England. *J Epidemiol Community Health* 2011;65:517–21.

36 Ujcic-Voortman JK, Baan CA, Seidell JC, Verhoeff AP. Obesity and cardiovascular disease risk among Turkish and Moroccan migrant groups in Europe: a systematic review. *Obes Res* 2012;13:2–16.

37 Agyemang C, Addo J, Bhopal R, et al. Cardiovascular disease, diabetes and established risk factors among populations of sub-Saharan African descent in Europe: a literature review. *Global Health* 2009;5:7.

38 Daryani A, Berglund L, Andersson A, et al. Risk factors for coronary heart disease among immigrant women from Iran and Turkey, compared to women of Swedish ethnicity. *Ethn Dis* 2005;15:213–20.

39 Dhawan J, Bray CL, Warburton R, et al. Insulin resistance, high prevalence of diabetes, and cardiovascular risk in immigrant Asians. Genetic or environmental effects. *Brit Heart J* 1994;72:413–21.

40 Kristensen JK, Bak JF, Wittrup I, Lauritzen T. Diabetes prevalence and quality of diabetes care among Lebanese or Turkish immigrants compared to a native Danish population. *Prim Care Diabetes* 2007;1:159–65.